Appendix B

Geotechnical Report

Eastern Region

U.S. 395 Route Development Plan

Spokane to Stevens County Line

Geotechnical Report

Route Development Plan
Spokane to Stevens County Line
SR 395, C.S. 3209, MP 172.00 to 183.69

Preliminary Geotechnical Review and Recommendations
Spokane County, Washington

Reviewed by:

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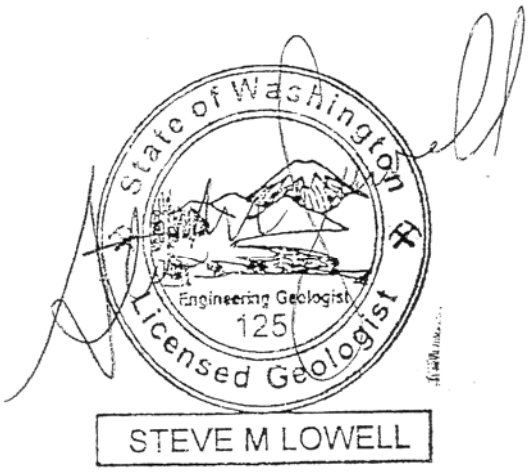

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INTRODUCTION

At the request of the Eastern Region Planning Section, we have reviewed the proposed route development plan for SR 395 between MP 172.00 and the Stevens County Line at MP 183.69 (Figure 1). It is our understanding that the proposed route development plan will improve the existing two-lane highway with at-grade crossings to a four-lane facility with interchanges, overcrossings, and undercrossings. The purpose of this geotechnical review is to provide preliminary geotechnical information for planning of the proposed undercrossings in the City of Deer Park and to perform a preliminary geotechnical reconnaissance along the project corridor.

GEOTECHNICAL INVESTIGATION

In early September, Charlene Kay and Brent Rasmussen from the Eastern Region and Doug Anderson from EEP Geotechnical Services conducted a field review along the project corridor. In addition to the field visit, a literature review and a historical air photo analysis were performed.

The field work primarily consisted of visiting each interchange, overcrossing, and undercrossing in the project corridor. Photographs were taken at some of the proposed intersections and a geotechnical test boring (HST-1-01) was advanced at the Cleveland / H Street intersection with SR 395. No lab tests were conducted on soil samples collected during advancement of this test boring. In addition, during the field reconnaissance in the City of Deer Park, a wetland located at the Short Road intersection with SR 395 was identified and its approximate limits were traced on to orthophotographs.

A review of previous literature included locating published geologic maps of the area and review of a past-geotechnical project file for the Dragoon Creek Bridge at MP 180.43. The Dragoon Creek Bridge (No. Is 395 / 460) is located near the Monroe / Crawford Road intersection with SR 395.

A historical air photo study of the City of Deer Park area was also completed as part of the preliminary geotechnical review of the alignment. This was primarily used to identify historical wetland limits prior to development in the wetland area at the Short Road crossing of SR 395 in the City of Deer Park.

SITE CONDITIONS

Climate and Vegetation

This project area lies within a continental climatic zone. Mean summertime maximum temperatures range from the mid 70's to the mid 80's Fahrenheit, and mean minimum winter temperatures range from the low 30's to mid 40's Fahrenheit. Average annual precipitation is 22.4 inches with 45 inches of that precipitation falling as snow between November and March.

The natural vegetation within the route development plan corridor is comprised of pockets of cottonwood, alder, and pine trees in areas where there is shallow bedrock or

the rock outcrops at the surface. The understory is primarily semi-barren bunch grasses. Farmers have cleared the land with deeper soils to plant crops and / or graze animals.

Project Corridor Description

The project corridor begins on a geographic feature referred to as Half Moon Prairie at roughly 2150 feet in elevation. Half Moon Prairie is an elevated terrace primarily composed of cobbles, gravels, and sands. The existing and proposed SR 395 route trends to the north and crosses the deeply eroded stream valley of Dragoon Creek in the vicinity of MP 174.5. At Dragoon Creek the alignment swings to the northwest and follows the southwest limits of the City of Deer Park. At the Dragoon Creek crossing, basalt outcrops are evident in the road cuts, but it appears that the cobbles, gravels, and sands overlie the much of the basalt between the crossing and the City of Deer Park. As SR 395 progresses to the north toward Deer Park, the highway dips into a broad, shallow depression at an elevation of approximately 2100 feet near the Short / Main Road intersection. The highway begins to climb to 2150 feet as it heads north along side the City of Deer Park and then shifts again to the northwest at the Dragoon Creek Bridge on the north side of Deer Park. From Deer Park to the Stevens County Line the alignment parallels Dragoon Creek to the east and Beaver Creek to the west. Once the alignment traverses the Dragoon Creek Bridge, it appears that the near surface soils are primarily composed of cobbles, gravels, sands, and some fine-grained soils.

Geology

Within the project corridor the geologic units primarily consist of Columbia River Basalt rock that has been overlain by a combination of fine-grained lake sediments, "Missoula Flood" deposits (cobbles, gravels, and sands), dune sands, and recent stream deposits.

The Columbia River Basalt lava flows originated from open fissure eruptions near the Washington, Oregon, and Idaho borders in the Miocene (17 to 13 million years before present). The basalt rock can be found in isolated outcrops between the Dragoon Creek crossing in the vicinity of MP 175.0 and the northern city limits of Deer Park at approximately MP 182 (Figure 2). The lava flow is Miocene-aged (15.6 and 16.5 million years before present) belonging to the Grande Rhonde Basalt member. The basalt surface is highly irregular as a result of erosion experienced during a number of catastrophic floods between 14,000 and 12,000 years ago. These floods are commonly referred to as the "Missoula Floods" and are described further below.

During the Pleistocene, (between 10,000 and 2 million years before present) vast continental ice sheets advanced as far south as the Spokane Valley. At least four and up to six advances of the continental glacial ice sheets have been detected during geologic studies in this area. The latest advance, which occurred between 14,000 and 20,000 years ago, had the greatest effect on the present day landscape. Glacial ice of the Purcell lobe is thought to have periodically blocked the Clark Fork River near the present day Idaho / Montana border, forming a great ice dam across the valley. Glacial melt water runoff into the upper Clark Fork watershed impounded behind the great ice dam, forming a vast lake in western Montana referred to as Glacial Lake Missoula. Estimates suggest the impounded lake covered over 3,000 square miles and contained an estimated 500 cubic miles of water. On average, the ice dam failed approximately every 30 years and it has

been speculated that the entire lake may have drained within a few days, resulting in a peak flow across the Columbia Plateau at 750 million cubic feet per second. The majority of this floodwater rushed through the Spokane River and Little Spokane River valleys enroute to the Columbia River. Though the number of floods are unknown, each flood event likely swept over the land and scoured deposits of the previous, catastrophic flood deposits, cutting new channels into the basalt bedrock, and leaving behind new deposits of boulders, cobbles, gravel, and sand. In less energetic environments, like the Dragoon Creek stream corridor, slack water deposits of chiefly sand and fine-grained lake sediments were deposited. The multiple, highly erosive flood events is largely responsible for the irregular bedrock surface we have observed along the project corridor.

Over the last 10,000 years (Holocene-age), streams and wind erosion have modified some of these earlier deposits creating younger stream deposits and some dune complexes within the project corridor (Figure 2).

PRELIMINARY GEOTECHNICAL REVIEW AND RECOMMENDATIONS

During the field visit in early September, four issues / areas were identified as potential design and construction problems. They were the Short / Main Road intersection, the Cleveland / H Street intersection, the Crawford / Monroe Road intersection, and the Dragoon Crossing in the vicinity of MP 174.5.

In addition to the four issues / areas identified during the preliminary geotechnical review of the proposed route, the Eastern Region Materials Engineer indicated that a source for aggregate materials will be needed near the project corridor to minimize haul distances for future projects in this area.

Short / Main Road Intersection

During the field reconnaissance, a wetland area was identified at the Short Road crossing of SR 395. The Route Development Plan proposes an undercrossing at the Short / Main Road intersection to eliminate the at-grade crossing. This proposal would result in a depressed crossroad approximately 5 to 10 feet below the existing SR 395 elevation to minimize the proposed fill height of an elevated SR 395 alignment.

A historical air photo analysis was conducted to evaluate the evolution of the wetland limits located at the Short / Main Road intersection with SR 395. Air photos from 1958, 1978, and 1999 were utilized to examine the wetland area over the last 43 years. Groundwater is evident at the ground surface surrounding the Short / Main Road intersection, and it has been reported that the high groundwater periodically floods the McDonalds basement adjacent to the intersection. It has also been reported that the wetland water level has not risen above the elevation of the Short / Main Road and SR 395 intersection since it was constructed.

As can be seen in Figures 3a, 3b, and 3c, limits of the wetland have shifted to the southeast since 1958. In 1958, 1978, and 1999 the wetland encompasses the Short / Main Road intersection with SR 395. It appears that the wetland is isolated in a closed depression bound by basalt bedrock. Ground and surface water probably enter the depression from the slopes to the west and south due to the presence of a basalt rock rib is

present immediately to the north of the Short / Main intersection. As development in the City of Deer Park has occurred since 1958, parts of the wetland have been filled-in, forcing wetland water and its limits to the southeast.

Based on the field reconnaissance and the historical air photo study, it is recommended that the Short / Main Road be constructed at its existing grade and SR 395 be raised to accommodate the undercrossing or SR 395 be placed at its current elevation and an overcrossing be constructed for the Short / Main Road. The wetland area at the Short / Main Road intersection with SR 395 is located in a closed depression with no conveyance for the wetland water, so constructing a roadway below the existing road elevations into the groundwater would not be prudent.

Another issue to consider if the mainline is raised approximately 30 feet above the existing road elevation is to shift the alignment far enough to the west to accommodate 2H:1V embankments without impacting buildings currently paralleling the east side of SR 395. A shift in the alignment will result in significant design and construction savings if the use of embankment retaining wall systems are avoided or minimized through the City of Deer Park.

Cleveland / H Street Intersection

At the Cleveland / H Street intersection in the City of Deer Park, the Route Development Plan proposes an undercrossing to eliminate the existing at-grade crossing. This proposal would result in a depressed crossroad approximately 5 to 10 feet below the existing SR 395 elevation to minimize the proposed fill height of an elevated SR 395 alignment.

Ponded surface water was observed in some areas around the Short / Main intersection with SR 395, but lush vegetation was primarily used in the historical air photo study to trace the approximate limits of the wetland area. A geotechnical test boring was drilled at the SR 395 intersection with H Street (Appendix A). The subsurface materials encountered in test boring HST-1-01 consists of loose, moist, stratified, poorly graded sand and gravel with silt from the ground surface to 10 feet below the surface. At approximately 10 feet below ground surface, a fine-grained, highly weathered, strong, basalt rock with discontinuities very closely spaced and in poor condition was encountered from 10 to 20 feet (Figure 4). No groundwater was observed in this test hole and no borehole instrumentation was installed at this location. The irregular basalt bedrock surface appears to be shallowly dipping to the east in this area. Basalt outcrops can be observed a few 100 feet west of SR 395 at the Cleveland / H Street intersection.

Based on the field review, historical air photo study, and advancement of one test hole boring, we do not anticipate high groundwater tables to effect design and construction of this intersection. However, rock excavation may require blasting methods and the use of such methods may be limited by city ordinance or liability of damaging proximal buildings and structures, so we recommend that the undercrossing or SR 395 mainline elevation be depressed no more than 5 feet below the existing ground surface in this intersection. If a shift to the west in the SR 395 alignment occurs as a result of the Short / Main Road geotechnical recommendation, then the undercrossing or SR 395 alignment will need to be at existing grade to avoid excavation in rock.

Crawford / Monroe Road Intersection

At the Crawford / Monroe Road intersection, the route development plan proposes an undercrossing to eliminate the at-grade intersection. The Crawford / Monroe Road intersection will be constructed at the existing grade and SR 395 will be raised 25 to 30 feet to accommodate the undercrossing. This intersection includes two crossings of Dragoon Creek, resulting in three proposed structures. One of the crossings is located immediately south of the intersection on SR 395 and the other is located just west of the intersection on Crawford Road. Substantial approach fills up to 30 feet in height are proposed for the raising of SR 395. It is our understanding, based on discussions with the Region that the SR 395 alignment through this area is fixed due to the location of a cemetery to the west and Dragoon Lake to the east.

A field reconnaissance and review of a geotechnical project file was used to provide preliminary geotechnical recommendations for this intersection. In 1996, a geotechnical investigation, analysis, and memorandum were produced for the widening of the SR 395 Bridge No. 395 / 460 crossing of Dragoon Creek at MP 180.43. Two geotechnical test borings (H-1-96 and H-2-96) were advanced and lab tests were conducted on selected soil samples to develop engineering properties for the subsurface soils (Figure 5)(Appendix A for test boring logs)(Appendix B for lab test data). A geologic cross-section is provided in Figure 6.

Basalt bedrock was encountered at approximately 60 to 65 feet from the ground surface and groundwater was encountered within 5 feet of the ground surface where the test holes were drilled. In addition, the upper 45 to 50 feet of soils encountered in H-1-96 and H-2-96 are saturated and range in density from very loose to stiff. As documented in the 1996 bridge widening project memorandum, the soils overlying the basalt rock are too weak to support bridge and traffic loads required for the project, so deep foundations placed on the basalt rock were needed to found the bridge structure.

With these geologic factors in mind, it is recommended that further geotechnical investigation be conducted for deep foundations and / or containing approach embankments with retaining walls to minimize wetland impacts.

Dragoon Creek Crossing in the Vicinity of MP 174.5

The existing crossing of the deep and wide Dragoon Creek Valley in the vicinity of MP 174.5 will be widened to accommodate the proposed four-lane facility. This will require extension of the existing box culvert and placement of additional embankment material ranging from 50 to 100 feet in height. No previous test holes or geotechnical reports were located during this initial geotechnical assessment. Since the proposed alignment utilizes the existing valley crossing location, we feel additional geotechnical work can be delayed until preliminary design work commences for this project.

Based on information presented in the Crawford / Monroe intersection, it is likely that weak, saturated soils overlie basalt in this valley. Therefore, we recommend that further geotechnical investigation be conducted for the proposed embankment and box culvert extension construction.

REFERENCES

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